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Special Article - Purchasing power parities and real expenditures - 1999 benchmark results for OECD countries

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SYNOPSIS

This article describes how "Purchasing Power Parities" (PPP's) (which provide a means of making comparisons of economic aggregates, such as gross domestic product, between countries based on a common currency unit) can be used for international comparisons. For most purposes PPP's are a better method of making such comparisons than that based on simple "exchange rate" conversions. Initial results from the OECD's 1999 round of comparisons are presented. An appendix summarises some of the more complex statistical issues involved in calculating PPP's, to help users understand why there is a roughly ±5% error margin involved in PPP's.

INTRODUCTION

Economic statistics for individual countries are commonly presented in several different ways:

- index numbers (typically used for presenting prices statistics such as the consumer price index)
- ratios (eg, the unemployment rate)
- national currency (eg, the national accounts or balance of payments).

A lot of economic analysis concentrates on what is happening within Australia, so expressing economic statistics in Australian dollars enables comparisons to be made easily between different sets of Australian data. However, from time to time, economists become interested in comparing Australian economic data with those for other countries. In some cases, it is fairly easy to do so (eg, comparing the recent growth rate of GDP in Australia with that in the USA). In such a case, the monetary units in which the data are expressed are not important because it is the rate of growth rather than the level of activity that is being compared. On the other hand, there is also interest in the relative levels of activity between countries and in obtaining an overall total measure of activity for a group of countries such as those in the Organisation for Economic Co-operation and Development (OECD). For example, it is common to see figures quoted for the level of GDP per capita in countries, as a measure of relative economic well-being, or an overall growth rate for all countries in the OECD. In the former case, the main problem in making the comparison is in adjusting the data expressed in national currency units to a common currency such as the $US. In the latter case, it is necessary to aggregate across different currencies (the euro, the British pound etc).

MAKING INTERNATIONAL COMPARISONS

A common method of converting economic data from a national currency to a common currency such as the $US is to simply use exchange rates. However, this simplistic approach can be quite misleading because exchange rates can be influenced by factors other than the relative volumes of goods and services produced in a country and traded with others (eg, financial flows or interest rates can have a significant effect on exchange rates) and therefore often do not reflect the relative purchasing power of different currencies. Also, not all goods are traded. A more robust method is to calculate "purchasing power parities" (or PPPs), which reflect the ratio of the prices in different countries of the goods and/or services produced.

The simplest example of a PPP is regularly presented by The Economist magazine, which shows the relative levels of the prices of McDonald's Big Mac hamburgers between various countries. This form of presentation provides an indication of which countries are "expensive" (ie, those whose PPP for a Big Mac is higher than the equivalent price based on exchange rates) and those that are "cheap". While the Big Mac approach is simplistic, being based on the relative prices of a very limited range of items, it does point to an approach that can be more broadly based.

To calculate PPPs, it is necessary to identify goods and services that are identical in all the countries involved in the comparison and for which prices can be collected. The goods and services concerned need to be representative of the expenditures in each country as well as being comparable between the countries. Tensions arise in identifying products that meet these two criteria, so compromises have to be made in the process.

More information on how PPPs are calculated and some of the technical issues associated with them are presented in the appendix to this article.

PER CAPITA VOLUME INDEXES

Calculating PPPs is the first step in making international comparisons of economic aggregates. The second step is to convert economic data expressed in national currency into a common unit (usually $US) by dividing the values by the PPP for the country concerned (with the United States PPP equaling one).

One of the most common uses of PPP-adjusted data is to calculate per capita volumes for major aggregates such as GDP. Per capita GDP is often used as an indicator of relative wealth between countries. Some commentators criticise its use in this way because it is an incomplete measure of wealth. However, it has the advantage of being the broadest economic measure regularly available across a wide range of countries and there is a high correlation between per capita GDP volumes and the wealth of a country.

Australia has participated in the last 5 rounds of the OECD's PPP Programme, which the OECD runs in conjunction with Eurostat (the statistical office of the European Union) - the most recent of which was conducted in respect of 1999. In presenting the results of the 1999 round, the OECD has emphasised the need to avoid reading too much into small differences between countries' GDP per capita, based on PPP conversions.

Using the per capita volume index based on PPPs to establish a strict order of ranking between countries can be misleading because, in some cases, a number of countries are clustered around a very narrow range of outcomes. Relatively minor differences in the measured per capita volumes can result in a different country order which may or may not be statistically significant (the OECD's rule of thumb is that there is potentially an error of about 5 percentage points in

PPPs and the per capita volumes derived from them). Therefore, four groupings have been used to provide a broad overview of the results for all 30 OECD countries that participated in the 1999 PPP round. The country indexes are based on the average of the 30 OECD Member countries "OECD30" = 100.

- a high-income group (above 120): Denmark, Iceland, Luxembourg, Norway, Switzerland and the United States of America;
- a high-middle income group (between 100 and 119): **Australia**, Austria, Belgium, Canada, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, Sweden and the United Kingdom;
- a low-middle income group (between 50 and 99): the Czech Republic, Greece, Hungary, Korea, New Zealand, Portugal, the Slovak Republic and Spain;
- a low-income group (less than 50): Mexico, Poland and Turkey.

COMPARATIVE PRICE LEVELS

A "comparative price level" is the ratio between a PPP and the corresponding exchange rate. Using Australia as an example, the 1999 PPP compared with the $US was 1.30 and the average exchange rate in 1999 was $A1.55 = $US1.00. Therefore, the comparative price level for Australia compared with the USA was 84 (1.30/1.55) in 1999, which indicates that the price level in Australia for the goods and services included in GDP was only 84% of that in the USA. Just as the OECD presented broad groups of countries based on their "income" (ie, GDP per capita), it also presented results in a similar way for relative price levels (USA = 100):

- a high price level group (above 110): Denmark, Iceland, Japan, Norway, Sweden and Switzerland;
- a medium-high price level group (between 90 and 109): Austria, Belgium, Finland, France, Germany, Ireland, Luxembourg, the Netherlands, the United Kingdom and the United States of America;
- a medium-low price level group (between 60 and 89): Australia, Canada, Greece, Italy, Korea, Mexico, New Zealand, Portugal and Spain;
- a low price level group (less than 60): the Czech Republic, Hungary, Poland the Slovak Republic and Turkey.

DETAILED RESULTS

The following table presents the detailed results for all 30 OECD countries for the 1999 PPP benchmark round. The PPPs are expressed in terms of $US = 1.00, while the price level indexes and the indexes of per capita GDP for each country are shown on the base of the average of the 30 OECD Member countries = 100.

It is important to note the OECD's warning that "at the level of GDP, a broad and arbitrary rule of thumb is that differences in indices of real final expenditure and real final expenditure per head need to be at least five percentage points to be considered as statistically significant" (OECD Purchasing Power Parities and Real Expenditures - 1996 Results, page 13).

TABLE 1: PPPS AND COMPARISONS OF GDP FOR OECD COUNTRIES - 1999

Country	PPPs ($US =1)	Price level indexes (OECD30 =100)	Per capita GDP (OECD30 =100)
Australia	1.3	84	109

Austria	13.0	102	113
Belgium	37.7	100	109
Canada	1.19	81	117
Czech Republic	13.5	39	60
Denmark	8.24	119	124
Finland	5.92	107	103
France	6.38	104	102
Germany	1.91	105	109
Greece	231	76	70
Hungary	98.4	42	51
Iceland	81.2	113	122
Ireland	0.724	99	114
Italy	1554	86	106
Japan	162	143	110
Korea	755	64	60
Luxembourg	39.7	106	190
Mexico	5.63	59	37
Netherlands	1.97	96	117
New Zealand	1.43	77	83
Norway	9.25	119	128
Poland	1.77	45	40
Portugal	127	68	75
Slovak Republic	13.6	33	49
Spain	125	80	84
Sweden	9.64	118	104
Switzerland	1.89	127	127
Turkey	197157	47	26
United Kingdom	0.65	106	103
United States	1.0	101	149
OECD 30		100	100
EU15 (a)	0.918	99	102

(a) The 15 Member States of the European Union (EU) are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and the United Kingdom
Source: Organisation for Economic Co-operation and Development (OECD)

The OECD released the summary results above in January 2002. The detailed results will be published later in 2002 in a publication similar to that containing the 1996 results.

The appendix to this article provides an overview of the statistical issues associated with calculating PPPs. It has been produced by taking excerpts from the OECD publication containing the 1996 results.

FURTHER INFORMATION

Further information on PPPs can be obtained from Keith Woolford on Canberra (02) 6252 6673 or email keith.woolford@abs.gov.au.

APPENDIX: STATISTICAL ISSUES RELATING TO PPPS (Excerpts from OECD Purchasing Power Parities and Real Expenditures - 1996 Results)

INTERNATIONAL COMPARISONS OF GDP

GDP is the aggregate used most frequently to represent the economic size of countries and, on a per capita basis, the economic well-being of their residents. It can be estimated using three alternative approaches which, in theory, yield the same result: the income approach, the

production approach and the expenditure approach.

Comparisons for the Programme are made from the expenditure side, which identifies the components of final demand: consumption, investment and exports and imports. The reasons are: first, the inherent usefulness of making comparisons from the demand side; second, the difficulties of organising comparisons from the supply side which require data for both intermediate consumption and gross output; and third, the generally better comparability among countries of their detailed breakdowns of final expenditure on GDP. The disadvantage of the expenditure approach is that, although it enables levels and structures of consumption and investment to be compared, productivity comparisons can only be made at the level of the whole economy.

Values of final expenditure on GDP are made up of two components: price and volume. Comparing the expenditure values of countries will not provide a comparison of the volume of goods and services purchased in the countries unless the price level differences that exist between them have been removed.

CURRENCY CONVERSION RATES

Before PPPs became available, exchange rates had to be used to express GDPs of countries in a common currency for the purpose of international comparison. The assumption underlying this practice is that exchange rates reflect the relative prices of domestically-produced goods and services in the different countries. However, many goods and services, such as buildings and government services, are not traded between countries. Moreover, other factors, such as relative interest rates and capital flows between countries, also have a significant impact on exchange rates and their influence is such that exchange rates do not adequately reflect the relative purchasing power of currencies in their national markets. GDPs of countries converted to a common currency using exchange rates reflect not only differences in the volumes purchased in the countries, but also differences in the price levels of the countries. As such they remain valued at national prices and are described as "nominal measures". This is because they are like a time series of GDP for a single country at current prices.

PPPs are currency conversion rates that convert to a common currency and equalise the purchasing power of different currencies. In other words, PPPs are both price deflators and currency converters; they eliminate the differences in price levels between countries in the process of conversion. This means that a given sum of money, when converted into different currencies by means of PPPs, will buy the same volume of goods and services in all countries. Conversely, the sums of national currency needed to purchase a given volume of goods and services in different countries will all equal the same amount of a common currency when PPPs are used as conversion rates. GDPs of countries expressed in a common currency using PPPs reflect only differences in the volume of goods and services purchased. As such they are valued at international prices and are called "real measures". This is because they are like a time series of GDP for a single country at constant prices.

TABLE A. GDPs OF THE UNITED STATES AND JAPAN AS A PERCENTAGE OF THE GDP OF THE EU15 IN 1985, 1990, 1993 AND 1996; AVERAGE ANNUAL VOLUME GROWTH RATES FOR 1985-1996, 1985-1990, 1990-1993 AND 1993-1996

Percentage with exchange rate converted GDPs	1985	1990	1993	1996
- EU15	100	100	100	100
- United States	142	85	91	86
- Japan	47	46	61	53

Percentage with PPP converted GDPs	1985	1990	1993	1996
- EU15	100	100	100	100
- United States	101	99	99	101
- Japan	36	40	40	41

Average annual volume growth rates	1985-96	1985-90	1990-93	1993-96
- EU15	2.2	3.1	0.5	2.4
- United States	2.4	2.8	1.4	3.0
- Japan	3.1	4.6	1.7	2.0

Table A gives a striking example of why PPPs rather than exchange rates should be used for international comparisons of volume. The table shows the GDPs of the United States and Japan expressed as a percentage of the GDP for the fifteen Member States of the European Union (EU15) for the years 1985, 1990, 1993 and 1996. There are two sets of percentages: one based on exchange rate converted data, the other based on PPP converted data. From the exchange rate converted data it appears that in 1985 the GDP of the United States was 42 per cent larger than that of the EU15, whereas the PPP converted data indicate that the two economies were of the same size. When comparing Japan and the EU15, the exchange rate converted data suggest that the GDP of Japan was almost half that of the EU15, while the PPP converted data show it to be just over a third. Similar large and contrary differences between the two sets of percentages also exist for 1990, 1993 and 1996. Exchange rate converted data are generally misleading on the relative sizes of economies. This is because exchange rates overstate the size of economies with relatively high price levels and understate the size of economies with relatively low price levels.

Table A also gives the average annual volume growth rates for four periods: 1985-1996, 1985-1990, 1990-1993 and 1993-1996. The average annual volume growth rates for the period 1985-1996 show that the economies of the United States and the EU15 grew approximately at the same rate. Yet from the exchange rate converted data, it appears that the GDP of the United States fell from being 42 per cent larger than that of the EU15 in 1985 to being 14 per cent lower in 1996. The PPP converted data show that the relative size of the two economies remained unchanged. For the period 1985-1990, the average annual volume growth rates for Japan and the EU15 were 4.6 and 3.1 respectively. From the exchange rate converted data, it appears that, although Japan's growth was noticeably higher than that of the EU15, its GDP fell marginally relative to that of the EU15. The PPP converted data for the same period indicate that the GDP of Japan grew faster than the GDP of the EU15. The changes in the relative sizes of the three economies over the four periods as measured by exchange rate converted data are not coherent with their relative growths for the same periods, whereas the changes as measured by PPP converted data are. PPP converted data are generally more consistent over time because PPPs do not fluctuate to the same extent as exchange rates.

PPP converted GDPs make better economic sense than do exchange rate converted GDPs. Exchange rate fluctuations can make it appear that countries have suddenly become "richer" or "poorer" even though in reality there has been no change in the volumes of goods and services produced. A moving average of exchange rates does not provide a more plausible picture. For example, from the exchange rate converted data in Table A, it can be derived that the GDP of Japan was 33 per cent, 54 per cent, 67 per cent and 62 per cent of the GDP of the United States in 1985, 1990, 1993 and 1996 respectively. These percentages would be 39, 59, 65 and 61 if five year moving averages are used. Neither set of results is economically plausible.

PURCHASING POWER PARITIES

PPPs are defined above as the rates of currency conversion that equalise the purchasing power of different currencies by eliminating the differences in price levels between countries. In their simplest form PPPs are nothing more than price relatives. For example, if the price of a cauliflower in France is 8.00 francs and in the United States it is 1.50 dollars, then the PPP for cauliflower between France and the United States is 8.00 francs to 1.50 dollars or 5.33 francs to the dollar. This means that for every dollar spent on cauliflower in the United States, 5.33 francs would have to be spent in France to obtain the same quantity and quality - or, in other words, the same volume - of cauliflower.

PPPs are not only calculated for individual products, they are also calculated for product groups and for each of the various levels of aggregation up to GDP (for example, from cauliflower to vegetables to fruit and vegetables to food to food, beverages and tobacco to household final consumption expenditure and, ultimately, to GDP).

PPPs are still basically price relatives whether they refer to a product group, an aggregation level or to GDP. It is just that in moving up the hierarchy of aggregation the price relatives refer to increasingly complex assortments of goods and services.

PRICE AND VOLUME MEASURES

PPPs are used to convert final expenditures on product groups, aggregates and GDP of different countries into real expenditures. PPPs and real expenditures provide the price and volume measures required for international comparisons. The PPPs and real expenditures for GDP are undoubtedly the most important, but the PPPs and real expenditures below the level of GDP are also useful in their own right.

TABLE B. PRICE AND VOLUME MEASURES FOR THE EU15, THE UNITED STATES AND JAPAN, GDP, 1996

	EU15	United States	Japan
Final expenditure on GDP at national prices in national currency	6,776.8	7,390.6	499,861
Population (millions)	374.1	265.6	125.9
Exchange rate (1 ecu .... units of national currency)	1.00	1.27	138
PPPs for GDP (1 ecu = ... units of national currency)	1.00	1.08	180
Real final expenditure on GDP at international prices in ecu (billions)	6,776.8	6816.1	2,783.6
Indices of real final expenditure on GDP (EU15= 100)	100	101	41
Real final expenditure per head on GDP at international prices in ecu	18,113	25,667	22,116
Indices of real final expenditure per head on GDP (EU15= 100)	100	142	122
Comparative price levels of GDP (EU15= 100)	100	85	130

Table B shows estimates of final expenditure on GDP at national prices in national currencies for the EU15 (in ECUs), the United States (in $) and Japan (in Yen) in 1996. The table also shows the estimates after they have been converted to real expenditures and the PPPs used to convert

them.

Three sets of indices have been derived using these data and the data on population and exchange rates, namely:

- Indices of real final expenditure: These are measures of volume. They indicate the relative magnitudes of the product groups or aggregates being compared. At the level of GDP they are used to compare the economic size of countries.
- Indices of real final expenditure per head: These are standardised measures of volume. They indicate the relative levels of the product groups or aggregates being compared after adjusting for differences in the size of populations between countries. At the level of GDP they are often used to compare the economic well-being of populations.
- Comparative price levels: These are defined as the ratios of PPPs to exchange rates. They provide a measure of the differences in price levels between countries by indicating for a given product group or aggregate the number of units of the common currency needed to buy the same volume of the product group or aggregate in each country. From the PPPs in Table B, it can be seen that if a given volume of GDP costs 100 ECU in the EU15, it costs 108 US dollars in the United States and 18,000 yen in Japan. To compare these costs, it is first necessary to express them in a common currency by converting them to ECU using the exchange rates in Table B. The comparative price levels so derived show that if a given volume of GDP costs 100 ECU in the EU15, it costs 85 ECU in the United States and 130 ECU in Japan. In other words, the general price level of the EU15 is higher than that of the United States, but lower than that of Japan.

The indices are shown with the EU15 as reference country, that is EU15 = 100, but they are not affected by the choice of reference country and can be rebased on either the United States or Japan. This is because the method used to calculate and aggregate the PPPs provides PPPs that are transitive (that is to say the ratio of the PPP between countries A and B and the PPP between countries B and C is equal to the PPP between countries A and C).

ACCURACY

GDP and GDP per head are often used to rank countries by economic size and economic welfare. However, neither the indices of real final expenditure on GDP nor the indices of real final expenditure per head on GDP should be used to establish a strict ranking of countries. They provide only an indication of the relative order of magnitude of economic activity or economic well-being in a country in relation to others in the comparison. The reason is that PPPs are statistical constructs rather than precise numbers. The error margins surrounding PPPs depend on the reliability of the expenditure weights and the price data as well as to the extent to which the particular goods and services selected for pricing by participating countries truly represent the price levels in each country. As is the case with national accounts data generally, it is not possible to calculate precise error margins for PPPs and the real expenditure levels derived from them. Nonetheless, at the level of GDP, a broad and arbitrary rule of thumb is that differences in indices of real final expenditure and real final expenditure per head need to be at least five percentage points to be considered as statistically significant. At the level of the main aggregates, error margins are larger and differences in indices of real final expenditure and real final expenditure per head will also need to be larger to be statistically significant. Below the level of the main aggregates, error margins are compounded by differences in national classifications used by participating countries in their national accounts.

BASIC DATA REQUIREMENTS

The calculation of PPPs requires each country participating in the comparison to provide a set of national annual average prices and a detailed breakdown of national expenditures. The prices should be for a selection of products chosen from a common basket of goods and services; the expenditures should be broken down by product group according to a common classification. Both prices and expenditures should refer to the year of the comparison and both should cover the whole range of goods and services included in final expenditure on GDP.

The prices are used to derive price relatives and then PPPs at the product group level, while the expenditures are used as weights with which to obtain PPPs at the various levels of aggregation above the product group level. Subsequently, the PPPs are used to convert the national expenditures into real expenditures. For this reason, the prices supplied by countries must be for items that are representative of their final expenditure on GDP and are comparable between countries, while the prices themselves should be consistent with the methods of valuation used to estimate the expenditures.

Failure to observe any of these three requirements will result in either an overestimation or underestimation of the price levels and, consequently, an underestimation or overestimation of the volumes:

- Representativeness: As there is an inverse relationship between prices and quantities, a comparison based on products that are not equally representative of all countries will result in biased price relatives. Price levels for countries having a smaller number of representative products will be overestimated, while price levels for countries with a larger number of representative products will be underestimated.
- Comparability: A comparison must be made using products that are comparable. Price relatives should be based on products whose quality and quantity are the same across countries. If not, differences in quality or quantity will be mistaken for price differences and will lead to the underestimation or overestimation of price levels.
- Consistency: The basis of a comparison is the identity: Expenditure = Price x Volume. Volumes are obtained by dividing expenditures by prices. If the volumes are to be estimated correctly, then the prices collected should be those used to obtain the expenditures. Using prices that are not consistent with those underlying the expenditure values will result in volumes being underestimated or overestimated.

The requirements of representativeness and comparability are not complementary. Countries will have different representative products and these will not be comparable. Conversely, products that are strictly comparable across the countries will not be equally representative. The Programme employs methods for selecting products and for calculating PPPs that are designed to respect both requirements. Inevitably compromises have to be made. Usually, in such cases, comparability is favoured over representativeness.

A comparison is primarily a price collecting exercise, but the prices are collected to effect a volume comparison of GDP and its component expenditures. They are not collected as a measure of price level differences in the first instance even though such comparisons are interesting in their own right. Adherence to the consistency requirement means that the prices to be collected are not necessarily those that are best suited for a price comparison. For most areas of expenditure there is no conflict between a price and volume comparison with both requiring national annual average market prices. However, in certain areas - specifically rents, medical goods and services, insurances, lotteries and non-market services - conflict can arise.

It is in these areas that ensuring the reliability of the volume comparison has to be given preference. For example, medical goods and services are often heavily subsidised and expenditure on them is split between households and government. If the prices each pays are used to deflate their expenditures separately, then the volume each purchases separately would

be correct, but the volume consumed, that is the sum of the two, would be overestimated. To avoid this, the Programme collects unsubsidised prices for medical goods and services and uses them to calculate PPPs that provide the correct volumes when applied to the combined expenditures of households and governments.

PRODUCT SELECTION

The common basket of goods and services used for the 1996 comparison was made up of product lists detailing the different types of goods and services to be priced.

The number of products selected for a basic heading varied greatly: from under five to over 50. The number selected depended on the type and the heterogeneity of the products covered by the basic heading, the homogeneity of the price ratios for the basic heading across countries as determined by the previous comparison, the availability of common representative products across countries and the importance of the basic heading as measured by its share of overall expenditure. The availability of common representative products was itself dependent on the number of participating countries, the extent to which their markets and expenditure patterns were similar, and the type of specification used to define selected products.

PRODUCT SPECIFICATION

Each product selected was defined by a product specification. This was to ensure that countries priced equivalent or comparable items, thereby avoiding the bias that can be introduced into the comparison by differences in quality. Ideally, all specifications would have been brand and model specific so that countries would have priced products of identical quality. In practice, this was not possible. Generic specifications, which just describe the relevant characteristics of the product to be priced without mentioning a particular brand and model, had also to be employed. Invariably some variability in quality between the products priced by countries occurred. Price data were rigorously edited. Countries were asked about apparent discrepancies and corrected price data were supplied in most cases. Mismatches in quality were dealt with by either rematching the prices reported (an ex-post refining of the specifications) or discarding them.

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